

Application No. 09/934,947
Communication dated December 16, 2005

Docket No. 1232-4756

Listing of Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (withdrawn): An optical element in which an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis is less than 10° .

Claim 2 (withdrawn): An optical element in which an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis is 0° .

Claim 3 (withdrawn): An optical element in which an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis of an optical system using the optical element is less than 10° , and preferably 0° .

Claim 4 (withdrawn): An optical element in which an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis of an optical system using the optical element is 0° .

Claim 5 (withdrawn): A manufacturing method for an optical element comprising the steps of:

growing an isometric crystal; and

forming the optical element from the isometric crystal that has been grown,

wherein the growing step includes the step of controlling growth so that a face orientation of the growing crystal is a $\langle 0\ 0\ 1 \rangle$ face.

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Claim 6 (withdrawn): A manufacturing method for an optical element comprising the steps of:

growing an isometric crystal; and

forming the optical element from the isometric crystal that has been grown, wherein the forming step is performed by slicing the isometric crystal parallel to a $\langle 0\ 0\ 1 \rangle$ face of the crystal.

Claim 7 (withdrawn): An optical element that is manufactured by a manufacturing method according to claim 5.

Claim 8 (withdrawn): An optical element according to claim 7, wherein an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis of the optical element and/or an optical axis of an optical system using the optical element is less than 10° .

Claim 9 (withdrawn): An optical element according to claim 8, wherein an angle between a $[0\ 0\ 1]$ axis of an isometric crystal and an optical axis of the optical element and/or an optical axis of an optical system using the optical element is substantially 0° .

Claim 10 (withdrawn): An optical element according to claim 1, wherein the isometric crystal is fluoride.

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Claim 11 (withdrawn): An optical system according to claim 10, wherein the isometric crystal is any one of calcium fluoride, barium fluoride, and strontium fluoride.

Claims 12-16 (canceled).

Claim 17 (previously presented): A projection optical system including more than one of the optical elements of a plurality of optical elements made of isometric crystals in which an angle between each $[0\ 0\ 1]$ axis of the isometric crystals and an optical axis of the optical system is less than 10° , the number of the optical elements is n , wherein the optical elements are located with one displaced from another around the optical axis so that an $[0\ 1\ 0]$ axis perpendicular to the $[0\ 0\ 1]$ axis of one of the optical elements and an $[0\ 1\ 0]$ axis perpendicular to the $[0\ 0\ 1]$ axis of another of the optical elements form an angle within $90/n \pm 10^\circ$ with each other.

Claims 18-23 (canceled).

Claim 24 (previously presented): An optical system including a plurality of optical elements made of isometric crystals in which an angle between each $[1\ 1\ 0]$ axis of the isometric crystals and an optical axis of the optical system is less than 10° , wherein said plurality of optical elements include at least two optical elements of which axes perpendicular to the $[1\ 1\ 0]$ axes are not parallel to each other.

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Claim 25 (previously presented): An optical system according to claim 24, wherein the angle between the axis of the isometric crystals and the optical axis is substantially 0°.

Claim 26 (original): An optical system according to claim 24, wherein the more than one of the optical elements is substitutive for an optical component derived from division of the optical elements in a plane perpendicular to the [1 1 0] axis.

Claim 27 (original): An optical system according to claim 24, wherein the optical system includes two of the optical elements, and a relative angle of axes of the two optical elements perpendicular to the [1 1 0] axis is 90°.

Claim 28 (original): An optical system according to claim 24, wherein the optical system includes two of the optical elements that are equal in thickness to each other, and each of the two optical elements is any one of a parallel flat plate and a lens.

Claim 29 (original): An optical system according to claim 24, wherein the isometric crystal is fluoride.

Claim 30 (original): An optical system according to claim 29, wherein the isometric crystal is any one of calcium fluoride, barium fluoride, and strontium fluoride.

Claim 31 (original): A projection optical system including an optical system according to claim 24.

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Claim 32 (original): A demagnification projection optical system including an isometric crystal as an optical element, wherein more than one of the optical elements at an image side in which an angle of marginal pencils of light passing through the optical element forms an angle of 24.6° or greater includes an optical element according to claim 26.

Claim 33 (previously presented): A projection optical system according to claim 31, wherein an angle between an $[1\ 1\ 1]$ axis and an optical axis with respect to a crystal orientation of an isometric crystal is less than 10° in optical elements except the more than one of the optical elements in the projection optical system.

Claim 34 (previously presented): A projection optical system according to claim 31, wherein an angle between an $[0\ 0\ 1]$ axis and an optical axis with respect to a crystal orientation of an isometric crystal is less than 10° in optical elements except the more than one of the optical elements in the projection optical system.

Claim 35 (previously presented): A projection optical system according to claim 31, wherein an angle between any one of an $[1\ 1\ 1]$ axis and an $[0\ 0\ 1]$ axis of an isometric crystal, and an optical axis is less than 10° in optical elements except the more than one of the optical elements in the projection optical system.

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Claim 36 (original): A projection optical system according to claim 34 including more than one of the optical elements according to claim 24, forming a first set of optical elements,

wherein a second set of optical elements within the first set of optical elements have the [0 0 1] axis substantially parallel with each other;

wherein the rest of the first set of optical elements, forming a third set of optical elements, have the [0 0 1] axis substantially parallel with each other and perpendicular to the [0 0 1] axis of the second set of optical elements; and

wherein a difference between a total thickness (element thickness on axis) of the second set of optical elements and a total thickness of the third set of optical elements is less than 10 mm.

Claim 37 (original): A projection optical system according to claim 33, wherein a relative angle of axes perpendicular to the optical axis of the optical elements except the more than one of the optical elements in the projection optical system is changed to reduce intrinsic birefringence.

Claim 38 (previously presented): An optical system according to claim 24 that uses a light source of which the wavelength is 200 nm or shorter.

Claim 39 (original): A projection optical system according to claim 38, wherein the light source is any one of an ArF excimer laser and an F₂ excimer laser.

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Claim 40 (canceled).

Claim 41 (previously presented): An optical system according to any one of claims 17 or 24-39, wherein the optical element is one of a lens, a diffraction grating, a parallel flat plate, an optical film, and a combination thereof.

Claim 42 (original): An exposure apparatus that uses ultraviolet radiation, deep ultraviolet radiation, or vacuum ultraviolet radiation as exposure light, which is projected onto an object to be processed through the optical system according to claim 41 to expose the object to be processed.

Claim 43 (withdrawn): A device manufacturing method comprising the steps of:

projecting the light for exposure onto the object to be processed using the exposure apparatus according to claim 42; and

performing a predetermined process against the object to be processed to which the light has been projected and exposed.

Claims 44-47 (canceled).